Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1.932
A2Ag8
no.196
cop.1

(ACE-196)

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Agricultural Chemistry and Engineering

NAVAL STORES REPORT

on

Production, Distribution, Consumption and Stocks

of

Turpentine and Rosin

of the

United States

By Crop Years

Covering Quarter - October 1 - December 31, 1942

Issued - February 22, 1943

LIBRARY
RECEIVED
★ MAR 20 1943 ★
U.S. Department of Agriculture

Compiled by

M. C. Lawrence

Naval Stores Research Division

FOREWORD

In addition to its regular Annual and Semi-Annual Naval Stores Reports on production, consumption and stocks of naval stores, the Naval Stores Research Division has, at the request of some of the War Agencies, begun the issuance of Quarterly reports. The issuance of these reports is authorized under Public No. 278, which directs the Secretary of Agriculture to collect, compile and publish statistics and essential information relating to spirits of turpentine and rosin produced, held and used in the domestic and foreign commerce of the United States.

In studying the data given in this, as well as in previous reports, it should be borne in mind that the Bureau of Agricultural Chemistry and Engineering merely assembles the figures from the individual reports received, and while care was exercised in the collection and compilation of the data, we cannot assume responsibility for their accuracy.

If production figures for this period are used as a basis for estimating this season's probable production, the fact that gum naval stores production is seasonal should be borne in mind. Normally, approximately 72 per cent of the total annual crop is produced from the beginning of April to the end of September. For this season, approximately 25 per cent of the total annual gum crop was produced during the quarter covered by this report - October 1 to December 31. Unusual weather conditions and difficulty in obtaining labor have apparently affected the percentage for gum naval stores production. Wood naval stores production, on the other hand, is not seasonal but is based largely upon probable consumer demand and to some degree upon labor.

As in previous reports, carryover (stocks) of turpentine and rosin is separated into gum and wood products. Stocks of wood rosin do not include so-called "B wood rosin." While sulphate turpentine is carried in the regular production and carryover tables, data on "liquid rosin" or "tall oil" are in a table separate from gum and wood rosins. The term "sulphate wood rosin" refers to the resin acids constituting approximately 42 per cent of "liquid rosin" or "tall oil."

Statistics on foreign production, imports and exports have been omitted from this issue.

These reports are designed to be of use to the industry---producer, factor, distributor and consumer, and the promptness of issue depends upon the cooperation of those reporting.

The Bureau of Agricultural Chemistry and Engineering extends its thanks to those producers, factors, distributors and consumers who have so kindly cooperated in furnishing the requested information.

SUMMARY OF TURPENTINE

SUPPLY, DISTRIBUTION AND CARRYOVER (Bbls. 50 gals.)

(By naval stores seasons beginning April 1 and ending the following March 31)

	1942-43 3 mos. (Oct. - Dec.)			1942-43 6 mos. (Apr. - Sept.)		
	Total	Gum	Wood	Total	Gum	Wood
TABLE 1a - SUPPLY AND DISTRIBUTION						
U. S. Carryover Oct. 1 [1]	244,028	173,615	70,413	*156,369	86,448	69,921
Production [2]	136,558	84,347	52,211	339,436	211,255	128,181
Imports [3]	-- not available --			-- not available --		
Available Supply	380,586	257,962	122,624	495,805	297,703	198,102
Less Carryover Dec. 31 [4]	293,100	220,298	72,802	**244,028	173,615	70,413
Appar. Total Consumption	87,486	37,664	49,822	251,777	124,088	127,689
Less Exports [5]	-- not available --			-- not available --		
Appar. U. S. Consumption	-- not available --			-- not available --		
TABLE 2a - CARRYOVER (Stocks)						
U. S. Carryover Oct. 1	244,028	173,615	70,413	*156,369	86,448	69,921
U. S. Carryover Dec. 31	293,100	220,298	72,802	**244,028	173,615	70,413
Increase	49,072	46,683	2,389	87,659	87,167	492

1/ Table 1a. 1942 Semi-Annual Naval Stores Report.
2/ Table 5a.
3/ Not available.
4/ Table 4a
5/ Not available

* Carryover Apr. 1
** Carryover Sept. 30

SUMMARY OF ROSIN

SUPPLY, DISTRIBUTION AND CARRYOVER (Bbls. 500 lbs. gross)

(By naval stores seasons beginning April 1 and ending the following March 31)

	1942-43 3 mos. (Oct. - Dec.)			1942-43 6 mos. (Apr. - Sept.)		
	Total	Gum	Wood	Total	Gum	Wood
TABLE 1b - SUPPLY AND DISTRIBUTION						
U. S. Carryover Oct. 1[1]	1,586,773	1,298,667	288,106	*1,434,677	1,230,817	203,860
Production[2]	531,566	300,574	230,992	1,243,151	697,736	545,415
Imports[3]	-- not available --			-- not available --		
Available Supply	2,118,339	1,599,241	519,098	2,677,828	1,928,553	749,275
Less Carryover Dec. 31[4]	1,843,827	1,518,612	325,215	**1,586,773	1,298,667	288,106
Appar. Total Consumption	274,512	80,629	193,883	1,091,055	629,886	461,169
Less Exports[5]	-- not available --			-- not available --		
Appar. U. S. Consumption	-- not available --			-- not available --		
TABLE 2b - CARRYOVER (Stocks)						
U. S. Carryover Oct. 1	1,586,773	1,298,667	288,106	*1,434,677	1,230,817	203,860
U. S. Carryover Dec. 31	1,843,827	1,518,612	325,215	**1,586,773	1,298,667	288,106
Increase	257,054	219,945	37,109	152,096	67,850	84,246

1/ Table 1b. 1942 Semi-Annual Naval Stores Report.
2/ Table 5b. Includes reclaimed gum rosin.
3/ Not available.
4/ Table 4 b.

* Carryover Apr. 1
** Carryover Sept. 30

DETAILS AND SUMMARY OF TURPENTINE CARRYOVER (Bbls. 50 gals.)

(At close of Dec. 31)

	1942 Dec. 31			1942 Sept. 30		
	Total	Gum	Wood	Total	Gum	Wood
TABLE 3a - DETAILS OF TURPENTINE CARRYOVER (Stocks)						
Production Points						
Gum Stills 1/	29,251	29,251	---	20,315	20,315	---
Wood Plants 1/						
Steam Dist. 2/	27,848	---	27,848	32,184	---	32,184
Sulphate	13,513	---	13,513	11,451	---	11,451
Dest. Dist.	338	---	338	474	---	474
Total	70,950	29,251	41,699	64,424	20,315	44,109
Sou. Concent. Points						
Ports 3/	73,635	73,635	---	56,788	56,788	---
Interior Yards	85,402	85,402	---	67,106	67,106	---
Total	159,037	159,037	---	123,894	123,894	---
Distrib. Points						
Eastern	16,774	5,444	11,330	18,463	6,782	11,681
Central	25,582	16,808	8,774	11,941	11,040	901
Western	6,432	3,600	2,832	8,040	5,152	2,888
Total 4/	48,788	25,852	22,936	38,444	22,974	15,470
Industrial Plants 5/	14,325	6,158	8,167	17,266	6,432	10,834
TABLE 4a - SUMMARY OF TURPENTINE CARRYOVER (Stocks)						
Production Points	70,950	29,251	41,699	64,424	20,315	44,109
Sou. Concent. Points	159,037	159,037	---	123,894	123,894	---
Distrib. Points	48,788	25,852	22,936	38,444	22,974	15,470
Industrial Plants	14,325	6,158	8,167	17,266	6,432	10,834
Total in U. S.	293,100	220,298	72,802	244,028	173,615	70,413

1/ Compiled from reports by producers and factors.
2/ Does not include by-products resulting from making paler grades from FF wood rosin
3/ Official Board of Trade and Chamber of Commerce Reports.
4/ Compiled from reports of individual distributors.
5/ Compiled from reports of individual consumers.

DETAILS AND SUMMARY OF ROSIN CARRYOVER (Bbls. 500 lbs. gross)
(At close of Dec. 31)

	1942 Dec. 31			1942 Sept. 30		
	Total	Gum	Wood	Total	Gum	Wood
TABLE 3b - DETAILS OF ROSIN CARRYOVER (Stocks)						
Production Points						
Gum Stills[1/]	186,743	186,743	---	129,113	129,113	---
Wood Plants[1/]						
Steam Dist.[2/]	206,549	---	206,549	166,172	---	166,172
Sulphate	---	---	---	---	---	---
Dest. Dist.	---	---	---	---	---	---
Total	393,292	186,743	206,549	295,285	129,113	166,172
Sou. Concent. Points						
Ports[3/]	418,028	418,028	---	383,361	383,361	---
Interior Yards	628,560	628,560	---	522,430	522,430	---
Total	1,046,588	1,046,588	---	905,791	905,791	---
Distrib. Points						
Eastern	10,956	6,466	4,490	10,628	5,464	5,164
Central	10,138	5,994	4,144	10,763	6,381	4,382
Western	1,411	106	1,305	1,697	306	1,391
Total[4/]	22,505	12,566	9,939	23,088	12,151	10,937
Industrial Plants[5/]	381,442	272,715	108,727	362,609	251,612	110,997
TABLE 4b - SUMMARY OF ROSIN CARRYOVER (Stocks)						
Production Points	393,292	186,743	206,549	295,285	129,113	166,172
Sou. Concent. Points	1,046,588	1,046,588	---	905,791	905,791	---
Distrib. Points	22,505	12,566	9,939	23,088	12,151	10,937
Industrial Plants	381,442	272,715	108,727	362,609	251,612	110,997
Total in U. S.	1,843,827	1,518,612	325,215	1,586,773	1,298,667	288,106

1/ Compiled from reports by producers and factors. Includes reclaimed gum rosin.
2/ Does not include byproducts resulting from making paler grades from FF wood rosin.
3/ Official Board of Trade and Chamber of Commerce Reports.
4/ Compiled from reports of individual distributors.
5/ Compiled from reports of individual consumers.

DETAILS OF PRODUCTION

(By naval stores seasons beginning April 1 and ending following March 31)

TABLE 5a - PRODUCTION OF TURPENTINE (Bbls. 50 gals.)

	1942-43 3 mos. (Oct.-Dec.) Total	Gum	Wood	1942-43 6 mos. (Apr.-Sept.) Total	Gum	Wood
Gum	84,347	84,347	---	211,255	211,255	---
Wood, Steam Dist.	29,604	---	29,604	85,011	---	85,011
" Sulphate	21,436	---	21,436	39,779	---	39,779
" Dest. Dist.	1,171	---	1,171	3,391	---	3,391
Total	136,558	84,347	52,211	339,436	211,255	128,181

TABLE 5b - PRODUCTION OF ROSIN (Bbls. 500 lbs. gross)

Gum	295,890	295,890	---	689,804	689,804	---
Reclaimed (gum)	4,684	4,684	---	7,932	7,932	---
Wood, Steam Dist.	230,992	---	230,992	545,415	---	545,415
" Sulphate (Table 5c)	---	---	---	---	---	---
Wood, Dest. Dist.	---	---	---	---	---	---
Total	531,566	300,574	230,992	1,243,151	697,736	545,415

TABLE 5c - PRODUCTION OF "SULPHATE WOOD ROSIN (TALL OIL)"

1942-43 Oct. - Dec.	1942-43 Apr. - Sept.
17,687 tons black liquor soap produced to be further processed.	36,098 tons black liquor soap produced to be further processed.

TABLE 6 - PRODUCTION OF GUM TURPENTINE BY STATES[1/]

3 mos. (Oct. - Dec.)

	1942-43 3 mos. (Oct. - Dec.)		1942-43 6 mos. (Apr. - Sept.)	
	Barrels	Percentage	Barrels	Percentage
South Carolina	1,604	1.90	3,132	1.48
Georgia	56,508	67.00	156,282	73.97
Florida	18,507	21.94	33,189	15.72
Alabama	5,955	7.06	15,235	7.22
Mississippi	1,547	1.84	2,628	1.24
Louisiana	226	0.26	789	0.37
Total	84,347	100.00	211,255	100.00

1/ A unit of naval stores consists of one 50-gallon barrel of turpentine and three and one-third round (500-lb.) barrels of rosin.

TABLE 7 - MISCELLANEOUS NAVAL STORES

(Bbls. 50 gals.)

	1942-43 3 mos. (Oct. - Dec.)		1942-43 6 mos. (Apr. - Sept.)	
	Production	Stocks	Production	Stocks
Pine Oil	28,012	16,392	63,911	15,634
Pine Tar	22,130	1,566	62,398	3,199
Dipentene	5,833	20,816	12,572	30,015
Monocyclic Hydrocarbons	4,977	13,935	6,125	9,790

TABLE 8a - REPORTED CONSUMPTION OF TURPENTINE IN UNITED STATES (Bbls. - 50 gals.)
(By naval stores seasons beginning April 1 and ending the following March 31)

	1942-43 (Oct. - Dec.) 3 mos,			1942-43 (Apr. - Sept.) 6 mos.		
	Total	Gum[1/]	Wood[1/]	Total	Gum[1/]	Wood[1/]
Abattoirs	0			0		
Adhesives and Plastics	151			313		
Asphaltic products	0			0		
Automobiles and wagons	150			103		
Chemicals and pharmaceuticals	15,782			33,570		
Ester gum and synthetic resins	0			0		
Foundries and f'dry supplies	215			466		
Furniture	100			170		
Insecticides and disinfectants	57			49		
Linoleum and floor covering	0			16		
Matches	0			0		
Oils and greases.	8			14		
Paint, varnish and lacquer	6,849			16,970		
Paper and paper size	0			0		
Printing ink	65			109		
Railroads and shipyards	2,220			4,765		
Rubber	13			56		
Shoe polish and shoe materials	2,858			4,790		
Soap	0			0		
Other industries	38			141		
Total industrial reported	28,506	11,996	16,510	61,532	23,920	37,612

1/ Separation of gum and wood turpentine consumption will be limited for the present to the total reported.

TABLE 8b - REPORTED CONSUMPTION OF ROSIN IN UNITED STATES (Bbls. - 500 lbs.)

(By naval stores seasons beginning April 1 and ending the following March 31)

	1942-43 (Oct. - Dec.) 3 mos.			1942-43 (Apr. - Sept.) 6 mos.		
	Total	Gum[1/]	Wood[1/]	Total	Gum[1/]	Wood[1/]
Abattoirs	121			188		
Adhesives and plastics	5,460			11,687		
Asphaltic products	753			2,646		
Automobiles and wagons	22			139		
Chemicals and pharmaceuticals	48,497			114,017		
Ester gum and synthetic resins	35,163			73,536		
Foundries and f'dry supplies	7,375			15,230		
Furniture	3			109		
Insecticides and disinfectants	1,260			2,596		
Linoleum and floor covering	7,409			24,319		
Matches	360			790		
Oils and greases	9,016			17,245		
Paint, varnish and lacquer	36,929			73,631		
Paper and paper size	89,396			176,198		
Printing ink	5,708			7,994		
Railroads and shipyards	2,741			1,990		
Rubber	648			1,404		
Shoe polish and shoe materials	1,810			3,569		
Soap	72,693			125,250		
Other Industries	2,334			7,016		
Total Industrial Reported	327,698	176,120	151,578	659,554	352,061	307,493

1/ Separation of gum and wood rosin consumption will be limited for the present to the total reported.

ADDENDA

Additional information pertaining to naval stores may be obtained as follows:

For biennial census of the production of turpentine and rosin, address: Bureau of the Census, Department of Commerce, Washington, D. C.

For information on the southern forest survey showing turpentine timber resources, address: Southern Forest Experiment Station, New Orleans, La.

For information regarding the production, distribution, consumption and stocks of turpentine and rosin, address: Bureau of Agricultural Chemistry and Engineering, Department of Agriculture, Washington, D. C.

1.932
A2Ag8
no.198
cop.1

ACE-198
Date: Jan., 1943

BINDER TWINE TESTS ON SEVERAL FARM CROPS

By W. R. Humphries and R. B. Gray
Division of Farm Mechanical Equipment
Bureau of Agricultural Chemistry and Engineering
Agricultural Research Administration
U. S. Department of Agriculture

LIBRARY
RECEIVED
★ APR 22 1943 ★
U. S. Department of Agriculture

In view of the binder twine shortage this Bureau, in cooperation with cordage companies, has given attention to the suitability of substitute and modified twines for use in harvesting farm crops. A study of the possibility of saving critical fibers by increasing the yardages per pound of our commonly used twines and by substitution of other materials, such as cotton and paper, was initiated with the 1942 small-grain harvest.

Engineers of the Bureau stationed in several typical grain-producing areas of the country were selected to supervise the testing of the twines in representative binders on farms. Tests were conducted mainly in Ohio, Iowa, Colorado and North Dakota on small grain and corn, in Maryland on small grain, in Arkansas 1/ on rice, in Kansas on feed sorghum, and in Wisconsin on hemp. Some additional work on feed sorghum was done under our direction on the Texas A. and M. Substation at Lubbock.

1/ Tests on rice were supervised by the Rice Branch Experiment Station of Arkansas.

The twines in the tests were manufactured principally from sisal, henequén, paper, and cotton either alone or in combination and in different yardages per pound.

Laboratory tests on the strength and other characteristics of the twines were conducted by the Southern Regional Research Laboratory of the Bureau as shown in Table 1.

Tests at time of harvest were made on more than 26,000 bundles of small grain including oats, wheat and barley; approximately 13,500 bundles of corn; and around 2,000 bundles of rice, sorghum, and hemp. The records therefore are considered a fair indication of the results likely to be obtained under conditions similar to those prevailing in 1942 and with the binders of various types and ages now in use on farms. Later observations were made in most cases to determine the durability of the twines as affected by weathering, handling of bundles, and insect damage.

Table 1. DESCRIPTION AND PHYSICAL PROPERTIES OF TWINES TESTED 1/

Item	Kind of Twine	Length per Pound (Feet)	Original Diameter (Inches)	Tensile Strength (Original) (Pounds)	Elongation (Percent)
1.	Standard (I.H.C.)	511.5	.075	91.9	7.5
2.	Sisal, 630 feet per pound	608.1	.067	86.6	4.9
3.	Sisal, 650 feet per pound	627.3	.055	86.5	5.1
4.	Sisal, 600 feet per pound	561.6	.061	102.3	4.7
5.	Henequén, 500 feet per pound	543.0	.075	78.3	6.8
6.	Henequén, 525 feet per pound	521.4	.081	83.5	7.1
7.	Deltox paper (single)	712.5	--	20.9	7.4
8.	Paper, Duplex	292.2	.112	73.5	9.6
9.	Paper-covered sisal: 1/3 paper, 2/3 Mexican sisal	438.9	--	80.5	10.5
10.	Paper-covered sisal: 1/2 paper, 1/2 African sisal	511.5	--	77.0	8.1
11.	Paper-covered sisal: 1/3 paper, 2/3 African sisal	536.4	--	71.8	9.0
12.	Paper-covered sisal: 1/2 paper, 1/2 African sisal	576.9	--	62.3	8.1
13.	Cotton, 32-ply	592.5	.079	78.2	14.2
14.	Cotton, 28-ply	661.8	.066	69.8	16.1
15.	Cotton, 24-ply	818.1	.068	58.8	12.6
16.	Sisal-Cotton, 60/40 (I.H.C.)	521.4	.072	72.2	8.1
17.	1/2 Sisal, Palmetto Tow, Twist 1:25	319.5	.107	67.3	5.3
18.	1/2 Sisal, Palmetto Tow, Twist 1:50	356.4	.112	67.8	6.9
19.	Sisal covered core of 4 No. 3 cotton strands	399.9	.088	100.7	8.5
20.	Sisal covered core of 2 No. 1 cotton strands	378.9	.092	102.5	9.7

1/ Tests made by the Southern Regional Research Laboratory of the Bureau of Agricultural Chemistry and Engineering, Agricultural Research Administration, U. S. Department of Agriculture, December, 1942.

In addition to the above, special twines were tested in the field as follows: single-ply 300-foot paper, sisal and cotton made of 4 strands of Nos. 3, 5, 4, and 5 cotton respectively, and Nos. 32 and 29 jute yarn spun in the core of sisal twine, referred to later.

GENERAL SUMMARY

The standard or common twine was used primarily for the initial and the best possible adjustment of the binder. Although the tests were concerned with substitute twines, comparable observations were made in a number of instances on the standard twine. In most cases the number of band failures with the standard twine was insignificant.

The sisal twines of 600, 630, and 650 feet per pound operated quite satisfactorily in the binding mechanism for small grain where an average of 99.4 percent of the bands were tied. The average number of bands tied with corn was 98.9 percent. The lighter 630- and 650-foot twines caused 50 percent more failures than the 600-foot twine with corn but were only slightly inferior when used on small grain. Failures with the lighter-weight twines resulted largely from thin or light sections in the twine. Sisal twines appeared to be equal to standard twine in binding rice.

The henequén 525- and 550-foot twines operated much the same as the sisal twines in the binding mechanism, the average band failure being 0.6 percent with small grain and 1.5 percent with corn. Both samples of henequén twine were considered equal to standard twine in harvesting rice under favorable conditions. Tangling of the henequén twine occured frequently, although this did not interfere much with the harvesting operation.

The paper twines, both single and double ply, could not be handled by the binder knotter. The twine was not sufficiently pliable for tying by the knotter. Furthermore, the twine usually broke near the knotter due to lack of tensile strength, or pliability, or both. Paper twine in the form prepared for these tests is not suitable for binding grain.

The paper-sisal twines tested in the field and listed in Table 1 as items Nos. 10 and 12, respectively, consisted of equal amounts of the two materials and two sizes of 500 and 600 feet per pound. On corn the lighter twine failed to tie 37 percent of the bundles and the heavier twine 32 percent, due primarily to breaking of the twine near the knotter. On small grain the failures were 1.6 and 2.5 percent, respectively, and resulted mainly from the twine pulling out of the holding disk. The heavier paper-sisal twine broke in the tying operation on hemp. Although the paper-sisal 50-50 mixture showed some promise with small grain, its failure with corn precludes its general use.

The number of failures with cotton twine of 24-, 28- and 32-ply averaged 1.5 percent with corn, 1.6 percent with small grain, and 2.5 percent with rice. The 24-ply cotton failed on 8 percent of the relatively heavy bundles of feed sorghum, because the knot was not tied. The use of an

old worn binder on the corn resulted in 10 percent failures with the 32-ply cotton, but eliminating this partially unfair trial, the proportion of failures with the 32-ply cotton is lowered to 0.5 percent, thus reducing the general cotton-twine average for corn from 1.5 to .9 percent. Difficulties encountered included the binding of the twine in the box, caused by improper shape of the ball or cone, and slipping of the twine from the knotter disk and bills. In some instances no failures occurred with binders which could be properly adjusted. Trials with hemp indicated that the heavier cotton twines might be reasonably satisfactory if provisions were made in the twine box to eliminate twine-feeding troubles.

Three samples of sisal-cotton twine were tested. These consisted of a sisal-covered cotton core of four cotton strands in each case but the weight of strands were Nos. 3, 4, and 5. This twine was tested on corn at one location, and on the average, it successfully tied 99.5 percent of the bundles. Comparable tests at this one location with dry or mature corn showed that the sisal-cotton twine was equally as good as standard twine. At another location this twine was tested on hemp where 99 percent of the bundles were successfully tied, the 4-4 and 5-4 twines performing with greater success than the 3-4.

The sisal-cotton twine gave further evidence of promise on the Texas A. & M. Substation at Lubbock, Texas on sorghum where observations were made on a small number of bundles tied with No. 4-4 ply, No. 3.5-4 ply, and 4 strands of 3.5-1 ply cotton yarn which was spun in the core of sisal twine. These twines ranged from 510 to 514 feet per pound with tensile strength of from 83 to 92 pounds. In the same series, runs were made with No. 22 and No. 29 jute yarn spun in the core of sisal twine. These twines ran 492 and 437 feet per pound, respectively, with tensile strength of 78 and 85 pounds. When this twine is wound around the bills of the binder in tying bundles, the jute core apparently does not stretch and consequently pulls out of the cord holder causing the bundle to miss. This twine gave negative results.

Two twines made of sisal and palmetto tow (marked twist 1.25 and twist 1.50) missed a large percentage of bundles when tried out on sorghum at Lubbock, Texas.

Weathering and damage from insect attacks and other causes after harvest were not serious during the 1942 season. Under the prevailing conditions none of the twines was materially damaged.

In general, the condition of the crops was favorable for harvesting operations and weather conditions were favorable for the bound crops and bands in the field after harvesting. It is quite likely that the conditions in other seasons would be less favorable and the twines would be subjected to more rigid requirements.

BINDER TWINE TESTS ON SMALL GRAIN

OHIO: In Ohio the binder twine tests embraced several makes of binders ranging in age from 3 to 20 years; and field conditions were such as to give a good try-out of the weathering characteristics of the bands. Tests were made on 525- and 550-foot henequén, 600-, 630- and 650-foot sisal, 28- and 32-ply cotton, and single-ply 300-foot paper. All of the twines except the paper were used successfully. After failure of the paper to function in the machine 33 bundles were tied by hand in order to observe weathering and insect damage to the bands while in the shock. It was noted that after a light rain the paper bands could easily be pulled loose, but after the bands had dried out they held very well. There were very few insects and no apparent insect damage was reported. The Deltox paper (single) sample with tensile strength of 20.9 pounds was entirely inadequate. The machine would not handle it, and bundles tied by hand with this twine could not be lifted without breaking the band.

With the 650-foot sisal one run of 867 bundles was made without a single miss. It was observed, however, that fairly loose bundles were being tied which obviated possible trouble as a few thin spots were noted in the twine. A second run on another binder with the same twine was recorded with 818 bundles tied with 4 (0.49 percent) misses, apparently due to thin spots in the twine. Two misses in 500 bundles tied in this latter binder were recorded with ordinary twine. Satisfactory results were also obtained with the other sisals regardless of the binder in which they were used. The cotton twines were generally satisfactory with the exception of the feeding from the twine box. It is noted from the tests carried out in this State that cotton would make a good substitute for ordinary twine as far as durability and handling by the knotter are concerned. The bands were practically free of failure due to weathering and insect damage. Some of the bands, including henequén 525-foot, sisal 600-foot, and cotton 28- and 32-ply, were in the shock 29 days without suffering damage. All of the twines were reported as being similar to the ordinary twine when cut with the feeder knives of the threshing machine.

IOWA: Tests were made with a 7-foot ground-drive binder about 20 years old reported as having a good knotter and twine disk, and other parts worn. Twines tested were henequén 525-and 550-foot, sisal 600-, 630- and 650-foot, cotton 28-ply and 32-ply, and single-ply 300-foot paper. Excluding paper, an average of .6 percent of the bundles missed in binding; in two of the tests more than 1 percent of the bundles missed. All but the paper twine were used successfully. The cotton twines twisted into kinks as drawn off the ball but the kinks straightened out after passing through the twine tension and caused no difficulty. There was some trouble due to cotton twine catching on the bottom of the ball, which is not of a proper shape to fit in the twine box.

While field damage to bands was comparatively light it was apparent that cricket damage was more common with the cotton twine than with the sisal twines. One inspection of 500 cotton bands showed cricket damage of 1.5 percent. Treatment by insect repellent for cotton twine would hence seem to be advisable.

If paper twine is an attractive material from the cost angle a twine not so stiff should be developed. A pliable paper twine treated for insects may have possibilities.

NORTH DAKOTA: In North Dakota small-grain tests were made with a horse-drawn 10-year-old binder on barley which was short and slightly lodged resulting in inferior bundles. Cotton 32-T 1/ and 32-B 2/ twines were satisfactory; .6 percent and 1.9 percent bundles respectively being missed. Considerable difficulty was experienced however with cotton 28-T and 28-B which was attributed to the kinking of the twine as it came from the can and to the twine disk mechanism being badly worn. No success was had with the single-ply 300-foot paper twine. Few grasshoppers and crickets were reported and two heavy rains - one a 4-inch downpour - occurred between two field inspections of the bands. All twines were at this time reported in good condition.

1/ Indicates pigtail at top of ball.
2/ Indicates pigtail at bottom of ball.

COLORADO: In duplicate binding tests made with henequen, sisal, and cotton twines on one 6-foot horse-drawn binder 30 years old and one 8-foot power take-off binder 5 years old failures were consistently higher for the old machine with an average of 1.4 percent bundle failures and an individual high of 4 percent against an average of 4 percent for the newer power machine with an individual high of 1.2 percent bundle failure. In the cotton twine tests trouble was caused by tangling in the box, as was generally experienced in other States. At threshing time the cotton bands seemed to have a little more slack in them than sisal. Tying failure of 4 percent was recorded with cotton 32-ply due to twine slipping through bills after the knife cut the twine. This cotton twine worked satisfactorily, however, on another binder. Single-ply 300-foot paper twine was reported too stiff for tying, cut too easily and wedged in grooves that had been made by the smaller twines.

Few grasshoppers were reported and fields were generally wet. No weathering or band damage in the field was reported.

The general observation of the operator was that all twines except cotton and paper gave equally good results.

MARYLAND: In Maryland all tests were made with farm operated binders. Satisfactory results were obtained with henequén 525- and 550-foot, sisal 600-, 630- and 650-foot, paper covered sisal ½-½ 500- and 600-foot, cotton 32-ply treated and untreated for insect control. The cotton twine was wound to feed from the outside and it was impossible to use it in the binder can. Consequently it was carried outside when making the tests. This difficulty can doubtless be overcome by winding so as to feed from inside the ball and it is suggested that some stiffening material be used to prevent collapse and tangling of the ball especially when it is almost used up.

The single-ply 300-foot and the duplex paper twines gave negative results. With the paper-covered sisal twines 500- and 600-foot the performance was as good or better than the twines ordinarily used on the farm except in one case where 2.5 percent of the bundles were missed because of failure of the twine disk to hold the twine. A slight increase in twine tension when using paper-covered twines is recommended.

Barley in North Dakota:

Observations at time of threshing, October 21, were made to supplement earlier observations on August 28, September 9 and October 2. These observations at time of threshing were made on the number of bands broken in the field when pitching the bundles from the shock to the wagon. Four percent of the cotton 32-B twine and 3 percent of the cotton 32-T were broken due mainly to considerable sprouting of the grain, thus requiring force to free the bundles from the ground. None of the sisal 630-foot bands were broken in loading 100 bundles. Only 1 percent of the cotton 28-B, cotton 28-T, and henequén 550-foot bands were broken.

BINDER TWINE TESTS ON CORN

Tests were made with corn binders using henequén 525- and 550-foot, sisal 660-, 630- and 650-foot, cotton 24-, 28- and 32-ply, paper-sisal 50-50, 500- and 600-foot, and a single paper twine made by a rug company at Oshkosh, Wisconsin which proved unsatisfactory. Tests were made in Colorado and Ohio with green corn and in North Dakota with dry frozen corn. With all twines except the papers straight or in combination bundle failures averaged for all States below 2 percent. The average data show no correlation between twine yardage and bundles missed nor between twine materials.

In Colorado cotton showed up to better advantage than sisal, - fewer bundles being broken in handling. In the lighter sisal a few bundles broke as they were being elevated to the rack and again when they were being unloaded from the rack to the silo filler, although they were properly tied.

In Ohio the 24-ply cotton seemed to have adequate strength for the dry and ripe corn on which it was used. It might prove to be somewhat light for green ensilage corn, however. The 28-ply was used on green ensilage corn and appeared to have adequate strength. Very good results were also shown by the tests of lighter weight of sisal. It would seem that the few failures due to thin spots in the lighter sisal twines could not cause serious objection during the emergency.

In North Dakota all tests were run on dry, frozen corn on which an average of less than 1 percent failures was recorded for all twines except the papers. The combination $\frac{1}{2}$-$\frac{1}{2}$ sisal-paper missed over 50 percent of the bundles with the 500-foot length and 60 percent for the 600-foot length. These findings were a reversal of those in Maryland on small grain where 2 percent of misses were recorded with the 600-foot length of combination twine.

In Iowa cotton 24-ply and 28-ply twine, and light-weight sisal gave reasonably satisfactory results on dry or ripe corn. The 24-ply cotton has adequate strength for dry corn but may be a little too light for green silage corn. The 28-ply cotton had sufficient strength for green corn. No serious objections were noted with the light-weight sisal twines.

Tests with cotton-sisal twine were conducted in Iowa on dry corn and on account of wet soil conditions the binder was operated on frozen ground early in the day. Three twine samples furnished by the International Harvester Company were used. The twine consisted of a cotton-center covered with sisal. The cotton cord was made up of four strands in each case and the weight of strands were No. 3, 4, and 5. The samples were designated sisal-cotton 3-4, 4-4, and 5-4. The first numeral indicates the weight of cotton strand and the last numeral the number of strands.

The use of the twine did not require any changes in the adjustment of the binder and no difficulties were encountered. The samples of sisal-cotton were equal to regular binder twine in the binding operation.

The sisal-paper (Pacord $\frac{1}{2}/\frac{1}{2}$) 500 and 600 gave band failures of 11.3 and 14.2 percent, respectively. The failures were due to breakage near the knotter. The paper covering was scuffed considerably and it was necessary to loosen the knotter bill tension. This substitute twine is not considered satisfactory for corn.

The Columbian standard twine gave 2.2 percent failures of bands; in most of these the twine pulled out of the knotter disk which may have been due in part to a worn disk. The standard twine was purchased the previous season. For more direct comparison the sisal-cotton 5-4 twine was again tested on 71 bundles without a failure. Under the conditions of this test the sisal-cotton 5-4 twine performed somewhat better than the standard twine.

Rice in Arkansas:

Tests were conducted with cotton twine both 28- and 32-ply, henequén 525- and 550-foot and sisal 600- and 650-foot on rice under unusually favorable harvesting conditions. The fields were dry during harvest and no rain fell until after threshing.

The use of the cotton twine did not require changes in the binder adjustment except a slight increase in the knotter bill tension. The cotton twine gave no trouble due to tangling but failed to feed properly under the ball in the box. Sharp threshing knives were required to cut the bands. Failure of the bands about 5 weeks after harvest amounted to 3 percent for the 32-ply. The 28-ply appeared to be too weak.

The henequén 525- and 550-foot and the sisal 600- and 650-foot were used on a heavy rice crop and appeared to be equal to regular binder twine. No difficulty was experienced.

Sorghum in Kansas:

Tests were conducted on feed sorghum with the following twines: single-ply 300-foot paper, cotton, and light-weight sisal both treated and untreated. The grain sorghum was 6 to 9 feet in height. The bundles weighed from 60 to 80 pounds each. A corn binder was employed.

The paper above referred to was not tested in the field but was used in the binding mechanism which was operated by hand. Apparently the twine was too bulky; it broke at the knotter in each of 25 trials regardless of the adjustment.

The cotton twine resulted in a 25-percent increase in tension at the twine box. The knotter failed to tie the twine properly in 8 percent of the bundles which is an excessive number of failures.

The sisal twine was used satisfactorily with no observed failures and difficulties.

Hemp in Wisconsin:

Cotton 32-T twine was used on hemp under favorable weather and field conditions. Band failures occurred in most cases when the binder was working in heavy and slightly tangled hemp. The cotton twine was rather difficult to cut and a sharp cutting edge on the knife must be maintained. The principal difficulty resulted from improper feeding of the twine from the ball in the twine box. When the diameter of the ball was reduced to about 3 inches, the cone assumed an inclined position and wedged in the box, thus causing the twine to break. Such difficulties might be avoided by placing the cone on a vertical spindle in the box.

Cotton 28-T twine gave results similar to the 32-T which was quite satisfactory with the exception of breakage in the twine box which could doubtless be largely eliminated.

Sisal-paper $\frac{1}{2}/\frac{1}{2}$ 500-foot twine failed in all cases.

Three combinations of sisal-cotton twines were tested; namely, 4 strands of No. 3 cotton, 4 strands of No. 4 cotton, and 4 strands of No. 5 cotton in combination with sisal fibers. No. 3 gave 1.3 percent failure in tying bundles, and Nos. 4 and 5 each gave .7 percent. Failure of knotter to tie properly was the chief cause of trouble which in this instance was not significant.

It has been estimated that the amount of twine required per acre for hemp is 4 pounds for an average crop and 6 pounds for a heavy crop.

Table 2. Results of tests with small grain

Kind of twine used	Binding test: Number of bundles bound	Binding test: Failures: Number	Binding test: Failures: %	Binding test: Failures: Cause	Subsequent band inspection: Number of bands inspected	Subsequent band inspection: Days after binding	Subsequent band inspection: Failures: Number	Subsequent band inspection: Failures: Cause
IN OHIO TESTS								
Standard			0.0	No failures				
Sisal, 630-foot	284	1	.4	Straw in bills	261	4	0	–
					250	7	0	–
	568	5	.9	Knotter	568	6	0	–
Sisal, 650-foot	867	0	0	--	654	9	1	Insect
	818	4	.5	Thin spots	734	11	0	–
Sisal, 600-foot	498	1	.2	Knotter	402	6	0	–
					476	9	0	–
					400	14	1	Insect
					420	22	0	–
					498	29	0	–
	472	3	.6	Knotter	394	10	0	–
Henequén, 550-foot	351	1	.3	Knotter	307	5	0	–
					300	8	0	–
	600	7	1.2	Knotter	600	6	0	–
Henequén, 525-foot	477	0	0	--	273	6	0	–
					430	9	0	–
					390	14	0	–
					400	22	0	–
					477	29	–	–
Paper (single-ply 300-foot)	Not usable - too stiff and broke at knotter							
Cotton, 32-B1/	411	1	.4	Straw in disk	350	6	0	–
					384	9	0	–
					370	14	0	–
					367	22	0	–
					411	29	0	–
	498	3	.6	Knotter	465	5	0	–
					422	10	0	–
Cotton, 32-T2/	567	2	.4	Knotter	539	9	0	–
	491	0	0	--	491	6	0	–
Cotton, 28-B	207	0	0	--	177	6	0	–
					188	9	0	–
					150	14	0	–
					170	22	0	–
					207	29	0	–
	71	1	1.0	Knotter	61	5	0	–
					50	8	0	–
Cotton, 28-T	520	10	1.9	Knotter	492	10	0	–
	431	3	.7	Do	431	6	0	–

1/ Pigtail at bottom of ball.
2/ Pigtail at top of ball.

Table 2 - Continued

Kind of twine used	Binding test: Number of bundles bound	Failures: Number	Failures: %	Failures: Cause	Subsequent band inspection: Number of bands inspected	Days after binding	Failures: Number	Failures: Cause
IN IOWA TESTS								
Standard	529	1	0.19					
Sisal, 630-foot	587	2	.3	-	587	9	1	Cricket
					587	14	0	-
Sisal, 650-foot	556	1	.2	-	556	9	0	-
					556	16	0	-
Sisal, 600-foot	502	7	1.4	Loose twine tension	502	9	0	-
Henequén, 550-foot	422	0	0		422	13	0	-
Henequén, 525-foot	570	4	.7	Twine pulled out of disk	570	13	1	Mouse
					570	26	1	Cricket
Paper, single-ply 300-foot	Not usable - too stiff and broke at knotter							
Cotton, 32-B	503	2	.4	-	503	12	2	Cricket
					503	22	8	Cricket
Cotton, 32-T	539	1	.2	-	539	12	3	Cricket
					539	22	0	-
Cotton, 28-B	517	5	1.0	-	517	11	0	-
					517	16	1	Knot untied
Cotton, 28-T	205	5	2.4	-	205	11	1	Cricket
					205	16	1	Cricket
IN COLORADO TESTS								
Sisal, 630-foot	524	3	.6	Straw in bills	524	16	0	-
	467	0	0	-	467	10	0	-
Sisal, 650-foot	526	2	.4	-	526	10	0	-
	536	6	1.1	-	536	16	0	-
Sisal, 600-foot	495	0	0	-	495	16	0	-
	542	4	.7	Straw in bills	542	16	0	-
Henequén, 550-foot	560	5	.9	Twine tangled	560	10	0	-
	549	3	.5	Straw in bills	549	16	0	-
Henequén, 525-foot	520	8	1.5	-	520	16	0	-
	522	0	0	-	522	-	-	-
Paper, single-ply, 300-foot	Not usable - too stiff and broke at knotter							
Cotton, 32-T	493	3	.6	Twine tangled	493	10	0	-
	497	20	4.0	Twine slipped thru bills	497	16	0	-
Cotton, 28-T	560	7	1.2	Twine tangling	560	10	0	-
	440	6	1.3	Twine breaking at knotter	440	16	1	-

Table 2 - Continued

Kind of twine used	Binding test: Number of bundles bound	Binding test: Failures Number	Binding test: Failures %	Binding test: Failures Cause	Subsequent band inspection: Number of bands inspected	Subsequent band inspection: Days after binding	Subsequent band inspection: Failures Number	Subsequent band inspection: Failures Cause
IN NORTH DAKOTA TESTS								
Standard			0.0	No failures				
Sisal, 630-foot	538	0	0	-				
Henequén	532	0	0	-				
Cotton, 32-B	538	10	1.9	-				
Cotton, 32-T	523	3	.6	-				
Cotton, 28-B	540	26	4.8	Worn twine disk				
Cotton, 28-T	472	15	3.2	-				
IN MARYLAND TESTS								
Sisal, 630-foot	200	6	3.0	Discharge arm maladjustment	200	17	0	-
Sisal, 650-foot	120	2	1.7	Disk tension	120	-	-	-
	330	0		-	330	11	0	-
	130	9	6.9	Knotter slipping of knot	130	17	0	-
Sisal, 600-foot	500	1	.2	Knotter	500	14	0	-
Henequén, 500-foot	160	2	1.2	Normal operation	160	17	0	-
Henequén, 525-foot	50	0	0	-	-	-	-	-
Paper, single-ply, 300-foot	Not usable - too stiff and broke at knotter							
Paper-sisal, 50-50, 500-foot	240	6	2.5	Disk failed to hold paper	240	14	0	-
	155	1	.6	Do	155	11	0	-
Do 600-foot	240	6	2.5	Do	240	14	0	-
	165	3	1.8	Do	165	11	0	-
Cotton, 32-T	330	12	3.6	Cotton slipped thru disk	330	11	0	-
(Treated)	180	1	.6		160	-	-	-
(Untreated)	330	12	3.6	Green material	330	0	-	-
Do	80	3	3.7	in knotter	80	-	-	-

Table 3. Results of tests with corn

Kind of twine used	Binding test: Number of bundles bound	Failures: Number	Failures: %	Failures: Cause
OHIO				
Sisal, 630-foot	560	3	.5	Thin spots in twine made knotter fail.
Sisal, 650-foot	630	10	1.6	Thin spots in twine probable cause.
	647	2	.3	Thin spots in twine noticeable.
Sisal, 600-foot	607	0	-	-
Henequén, 550-foot	600	6	1.0	Half of failures not due to twine.
Henequén, 525-foot	552	3	.5	Same as normal operation.
Cotton, 32-ply	860	3	.4	Knotter failure.
T 1/	320	32	10.0	Binder 20 years old and badly in need of new twine eyes; knotter twine kinking from box necessitates operation with loose knotter tension to avoid failures.
T	110	1	9	
T	620	1	.2	Knife must be sharper than with ordinary twines.
Cotton, 28-ply				
B 2/	485	5	1.0	Knotter failure, later corrected.
B	750	8	1.1	Knotter failure, later corrected.
	720	5	.7	Same as normal operation.
Cotton, 24-ply	444	11	2.5	Same as with ordinary twine. Binder not adjustable for these tests.
	468	0	.0	Tended to kink but performance better than ordinary twine.
IOWA				
Columbian standard	277	6	2.2	Pulled out of disk.
Sisal-cotton (I.H.C.)				
3-4	99	0	0	
4-4	190	1	0.5	
5-4	103	1	1.0	
Sisal-paper #5 ½/½ 500-foot	62	7	11.3	Break near knotter.
Sisal-paper #6 ½/½ 600-foot	84	12	14.2	Break near knotter.

1/ Pigtail at top of ball.
2/ Pigtail at bottom of ball.

Table 3 - Continued

Kind of twine used	Binding test: Number of bundles bound	Failures: Number	Failures: %	Failures: Cause
COLORADO				
Sisal, 630-foot	446	7	1.6	Broke on conveyor. 1/
Sisal, 650-foot	454	8	1.8	Broke in elevator. 2/
Sisal, 600-foot	450	11	2.4	Broke on conveyor.
Henequén, 550-foot	387	7	1.8	Twine tangled.
Henequén, 525-foot	381	10	2.6	Twine tangled in box.
Cotton, 32-ply	467	3	.6	
Cotton, 28-ply	573	8	1.4	
NORTH DAKOTA				
Sisal, 650-foot	100	1	1.0	Corn frozen and dry.
Sisal, 600-foot	99	0	0	Corn frozen and dry.
Henequén, 525-foot	108	1	0.9	Corn frozen and dry.
Cotton, 28-ply	96	0	0	Corn frozen and dry.
Sisal-paper, ½/½ 500-foot	15	8	53.0	Break near knotter.
Sisal-paper, ½/½ 600-foot	5	3	60.0	Break near knotter.

1/ One band broke while unloading.
2/ Two failures occurred in handling.

Table 4. Results of tests with rice, feed sorghum and hemp

Kind of twine used	Binding test: Number of bundles bound	Failures: Number	Failures: %	Failures: Cause
AT STUTTGART, ARKANSAS - RICE				
Cotton, 28-T	300	5	1.5	Not tied 1/
		5	1.5	Other causes
Cotton, 32-T	500	5	1	Not tied 2/
		5	1	Twine in box under ball
Henequén, 525-foot) Henequén, 550-foot) Sisal, 600-foot) Sisal, 650-foot)	No trouble in binding and no appreciable breaking of bands at threshing. As satisfactory as regular binder twine.			
AT HUTCHINSON, KANSAS - FEED SORGHUM				
Paper, single-ply 300-foot	25	25	100	Break at knotter
Cotton, 24-ply	200	16	8	Not tied
Light weight sisal	200	0	0	
AT WAUPUN, WISCONSIN - HEMP				
Sisal-cotton, 3/4	301	4	1.3	Failure of knotter to tie properly
Sisal-cotton, 4-4	305	2	.7	" " " " " "
Sisal-cotton, 5-4	300	2	.7	" " " " " "

1/ Thirty days after binding 10 failures were observed due to weak twine.
2/ Thirty-eight days after binding 4 failures were observed due to poor knots.

Table 5. Total and Average Results for Small Grain

	Twine	Number of bundles bound	Failures: Total number	Failures: Average percent	Causes
1.	Standard		Insignificant		
2.	Sisal, 630-foot	3168	17	0.7	Straw in knotter
3.	Sisal, 650-foot	3883	22	0.6	Thin spots and slipping of knot
4.	Sisal, 600-foot	3009	16	0.5	Knotter and straw in bills
5.	Henequén, 550-foot	3174	18	0.6	Knotter - straw in bills - twine tangled
6.	Henequén, 525-foot	2139	12	0.5	Twine pulled out of disk
7.	Deltox paper, single	-	-	100.0	Too weak
8.	Paper, duplex	-	-	100.0	Too stiff - broke at knotter
9.	Sisal and paper-sisal, 1/3 x 2/3 Mexican, 500-foot				Received too late for testing
10.	Sisal and paper-sisal, 1/2 x 1/2 African, 500-foot	240	6	2.5	Disk failed to hold twine
11.	Sisal and paper-sisal, 1/3 x 2/3 African, 600-foot				Received too late for testing
12.	Sisal and paper-sisal, 1/2 x 1/2 African, 600-foot	560	10	1.6	Disk failed to hold twine
13.	Cotton, 32-ply	5980	73	1.5	Knotter - twine slipped thru bills & disk
14.	Cotton, 28-ply	3963	78	1.8	Knotter - twine broke and tangled
15.	Cotton, 24-ply				Received too late for testing
16.	Sisal-cotton, 3/4				Received too late for testing
17.	Sisal-cotton, 4/4				Received too late for testing
18.	Sisal-cotton, 5/4				Received too late for testing

Table 6. Total and average results for corn

		Number of bundles bound	Failures: Total number	Failures: Average percent	Causes
1.	Standard				
2.	Sisal, 630-foot	1584	20	1.3	Thin spots in twine
3.	Sisal, 650-foot	1831	21	1.2	Thin spots in twine
4.	Sisal, 600-foot	1151	11	0.8	Broke in conveyor
5.	Henequén, 550-foot	987	13	1.4	Twine tangled in box - binder could not be properly adjusted
6.	Henequén, 525-foot	1445	24	1.6	Twine tangled in box - binder could not be properly adjusted
7.	Deltox paper, single				Not tested
8.	Paper, duplex				Not tested
9.	Sisal and paper-sisal, 1/3 x 2/3 Mexican, 500-foot				Recieved too late for testing
10.	Sisal and paper-sisal, 1/2 x 1/2 African, 500-foot	77	15	32.0	Broke near knotter
11.	Sisal and paper-sisal, 1/3 x 2/3 African, 600-foot				Received too late for testing
12.	Sisal and paper sisal, 1/2 x 1/2 African 600-foot	89	15	37.0	Broke near knotter
13.	Cotton, 32-ply	2377	40	2.4	Knotter failure - and knife not sharp enough. High percent of failures due to 10 percent failure with a 20-year old binder-Average of 4 tests out of the 5 was 0.5 percent failures.
14.	Cotton, 28-ply	2624	26	0.8	Knotter failure
15.	Cotton, 24-ply	912	11	1.3	No failures with binder in proper adjustment
16.	Sisal-cotton, 3/4	99	0	0	--
17.	Sisal-cotton, 4/4	190	1	0.5	--
18.	Sisal-cotton, 5/4	103	1	1.0	--